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OFFSHORE RESEARCH AND ENGINEERING.. R H CUTHBERTSON
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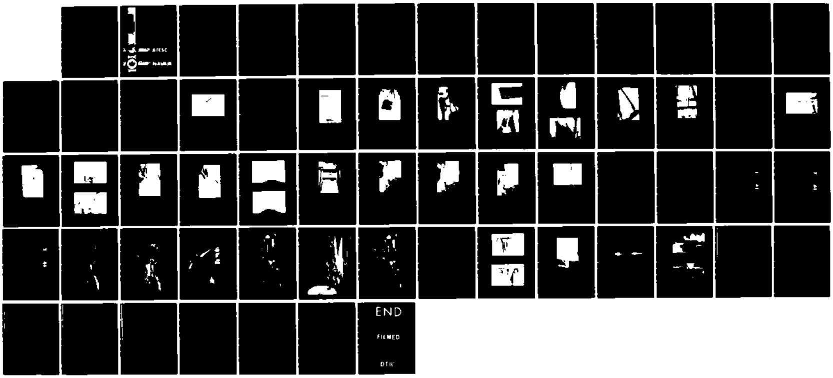

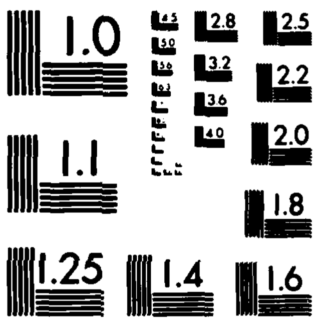
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ESL-TR-84-12

Aircraft Skin Penetrator and Agent Applicator, Volume I, Working Model Development and Construction (Volume I of II)

R.H. CUTHBERTSON

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NOVEMBER 1984

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SEPTEMBER 1982 - MARCH 1983

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This report covers development and construction of an aircraft skin penetrator device to provide rapid penetration and allow placement of a suitable fire-suppressing agent onto the base of an aircraft fire. Volume I discusses in detail the research conducted on the development of the proposed working model of the Aircraft Skin Penetrator/Agent Applicator. The report contains photographs of the different concepts considered.

Volume II has detailed drawings showing the construction of the working model Penetrator and sketches which show how the Penetrator may be used to fight aircraft fires.

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PREFACE

This report was prepared by AMETEK Inc., 1224 Coast Village Circle, Santa Barbara, California 93108, under contract number F08635-82-C-0472, for the Air Force Engineering and Services Center, Engineering and Services Laboratory (AFESC/RDCS), Tyndall Air Force Base, Florida 32403, and the Naval Air Systems Command (NAVAIR), Washington, D.C. 20361.

This report summarizes work done between 17 September 1982 and 15 December 1983. HQ AFESC/RDCS program manager was Joseph L. Walker, and NAVAIR Fire Protection Technical Manager was James L. Calfee.

This report has been reviewed by the Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public including foreign nationals.

This technical report has been reviewed and is approved for publication.

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Program Manager

ROBERT E. BOYER, Colonel, USAF
Director, Engineering and Services Laboratory

EVERETT L. MABRY, Lt Col, USAF
Chief, Engineering Research Division

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SECTION I

INTRODUCTION

A. BACKGROUND

Effective fighting and suppression of aircraft fires frequently require application of a fire-extinguishing agent to internal, enclosed spaces. Access to such spaces may often be severely limited for one or more of the following reasons:

- Unavailability of doors or access ways.
- Inoperability of the normal access doors or covers.
- Smoke and fire conditions.
- Elevation above positions easily reachable by firefighting personnel.

Current Air Force firefighting equipment does not provide for rapid access to aircraft fires which occur in airframe voids where access ports are either limited or not provided. Various aircraft sizes, configurations, and the use of high-strength metal alloys make forced entry to these areas time-consuming and difficult. Correction requires a lightweight, hand-held, self-powered device, which will penetrate aircraft skin and serve as a discharge outlet to dispense fire-extinguishing agent.

The skin penetrator/agent applicator is a means for rapid penetration of the skin and placement of a suitable hose and nozzle system to a point within the space for rapid application of agent.

There has been a long-standing interest in achieving improved firefighting with a skin penetrator/agent applicator and considerable effort has been made over the years to develop an effective design and tool. This effort is illustrated by some of the early patent activity shown in the following chart.

Patent	Date	Assigned	Description
2,235,915	3-25-41	E. Bohan	Simple penetrator tip for connection to a fire extinguisher for injecting agent into structural wall spaces. Penetration accomplished by pushing with hand.

Patent	Date	Assigned	Description
2,548,621	4-10-51	A. Rutledge	Simple penetrator tip for connection to a fire extinguisher with penetration accomplished by driving with a hand-held hammer.
2,756,829	7-31-56	J. Phillips	Penetrator tip for fire extinguisher for use with automotive vehicle or aircraft fires. Penetration accomplished by hand-held ram pressure.
4,219,084	8-26-80	NASA	Skin penetrator with a slidable mass or hand-held hammer actuator.

Similar work was done by the Air Force (Reference 1), by the Federal Aviation Administration (Reference 2), and by NASA (Reference 3).

These early efforts established the formidable nature of achieving a practical, usable tool design. For a variety of reasons, none of the efforts resulted in significant tool acceptance.

The Bohan and Phillips hand push-through penetrators and the Rutledge and NASA impact penetrators all require a major amount of human muscle power and energy to achieve penetration. While these tools may have application merit in some situations, the full range of skin thicknesses, hardnesses, and materials found on Air Force aircraft is beyond the range of human strength capability in the short time available for tool use in a fire situation.

The Air Force design effort produced a usable penetrator but this requires use of an explosive cartridge that has attendant storage, use, and safety restrictions.

A concept has been developed for a skin penetrator/agent applicator to meet the stringent Air Force requirements. Risks were reviewed and assessed, concept functional tests were conducted, and the confidence in meeting requirements is high.

B. THE CONCEPT

1. The Skin Penetrator/Agent Applicator

The Skin Penetrator/Agent Applicator employs a pre-charged pneumatic cylinder of small size for energy storage, a standard commercially available pneumatic drill for energy transfer, and a small compact human-engineered assembly package of all the components.

The energy storage is sufficient to penetrate 6 to 8 holes in the heaviest wall aircraft airframe constructed.

A small gauge is provided to verify the fully charged readiness of the tool.

Charging may be accomplished using standard breathing bottle equipment presently in place at most firefighting facilities.

A quick-connect/disconnect fitting is provided for the agent supply line with a standard firefighting type of quarter-turn, ball-shutoff valve.

The compressed air storage bottle is secured with quick-acting over-center toggle clamps for ease of assembly and periodic interchange of bottles, as required.

The bottle is charged to 2200 psig on the compressed air facilities used for changing the breathing bottle. A regulator controls pressure to the energy transfer system at 100 psig, with flow initiated by an index-finger-actuated trigger.

2. Recommendations

It was decided to proceed with development of the Skin Penetrator/Agent Applicator as described above.

Contract F08635-82-C-0472 was issued to AMETEK, Inc./ Offshore Research and Engineering Division to develop, construct, test and evaluate an aircraft Skin Penetrator/Agent Applicator for improved firefighting effectiveness. The work under the contract was to be conducted in three phases.

Phase	Title
I	Working Model Development
II	Working Model Construction
III	Test and Evaluation

This report covers Phases I and II and includes drawings, specifications and material selections.

SECTION II

PHASE I - WORKING MODEL DEVELOPMENT

A. OBJECTIVES

The objectives of the Skin Penetrator/Agent Applicator development are as follows:

1. Penetration Requirements

The tool shall penetrate USAF aircraft skin materials and whatever internal thermal or acoustical insulation materials and cabin panels that may be in place. The penetrator device shall penetrate at least 14 inches.

2. Mechanical Actuation

The tool shall be mechanically actuated and safe to operate in any explosive or flammable environment. The device shall not incorporate ballistic or explosive propellant materials.

3. Operation by One Person

The tool shall be operated by one person from a variety of positions, from hip level to overhead at arm's length and from various footing including the ground, aircraft surfaces and from a ladder.

4. Halon 1211 Delivery

The tool shall be suitable for delivery of Halon 1211 fire suppression agent.

5. P-13 Vehicle Base

The tool shall be designed to be fully functional from a P-13 vehicle as the operational base.

6. Quick-Disconnect

The tool shall have a quick-disconnect capability for both input connection and nozzle output connection.

7. Halon 1211 Discharge Rate

The tool shall be capable of discharging Halon 1211 at 5 to 5.5 pounds/second.

8. Throw Range

The tool shall be designed to have an effective throw range of not less than 30 feet.

9. "Trigger" Type Turn-On

The tool shall have a "trigger" type of actuation turn-on with a lock-on dispensing capability.

10. Retention System

The tool shall have suitable retention means to prevent penetrator from falling out during use, if unattended. (Note: Mechanical or nonmechanical means are acceptable.)

11. "Human-Engineered"

The tool shall be "human-engineered" for operational use by a single Air Force firefighter wearing full protective proximity clothing, including gloves, as required for a realistic fire environment.

B. TECHNICAL APPROACH

The technical approach for the design and development of the tool is shown in Figure 1, the overview flow chart of the program.

1. Initial Design Approach

An initial effort was made to design a tool which could be energized quickly by hand- or foot-assisted cocking of an energy storage means such as a tension or compression spring. Penetration would be achieved by releasing the spring to project the penetrator point and shaft through the aircraft skin in harpoon fashion. Such a tool would resolve the issue of handling a propellant charge as required for the Air Force AFCEC ER 74-8 tool (Reference 1). Analytic studies of the concept established a significant number of technical questions relating to the amount of energy required to project a point and shaft through typical aircraft skins. In addition, the implications of recoil to the safety of the operator were questioned. Accordingly, an experimental program was conducted to obtain physical test data.

2. Penetration Testing - Energy Requirements

A wooden buck was constructed to provide a mounting base for typical aircraft skin panels of aluminum and other alloys. As shown in Figure 2, the buck was constructed of two heavy plywood bulkhead sections, 16 inches apart with

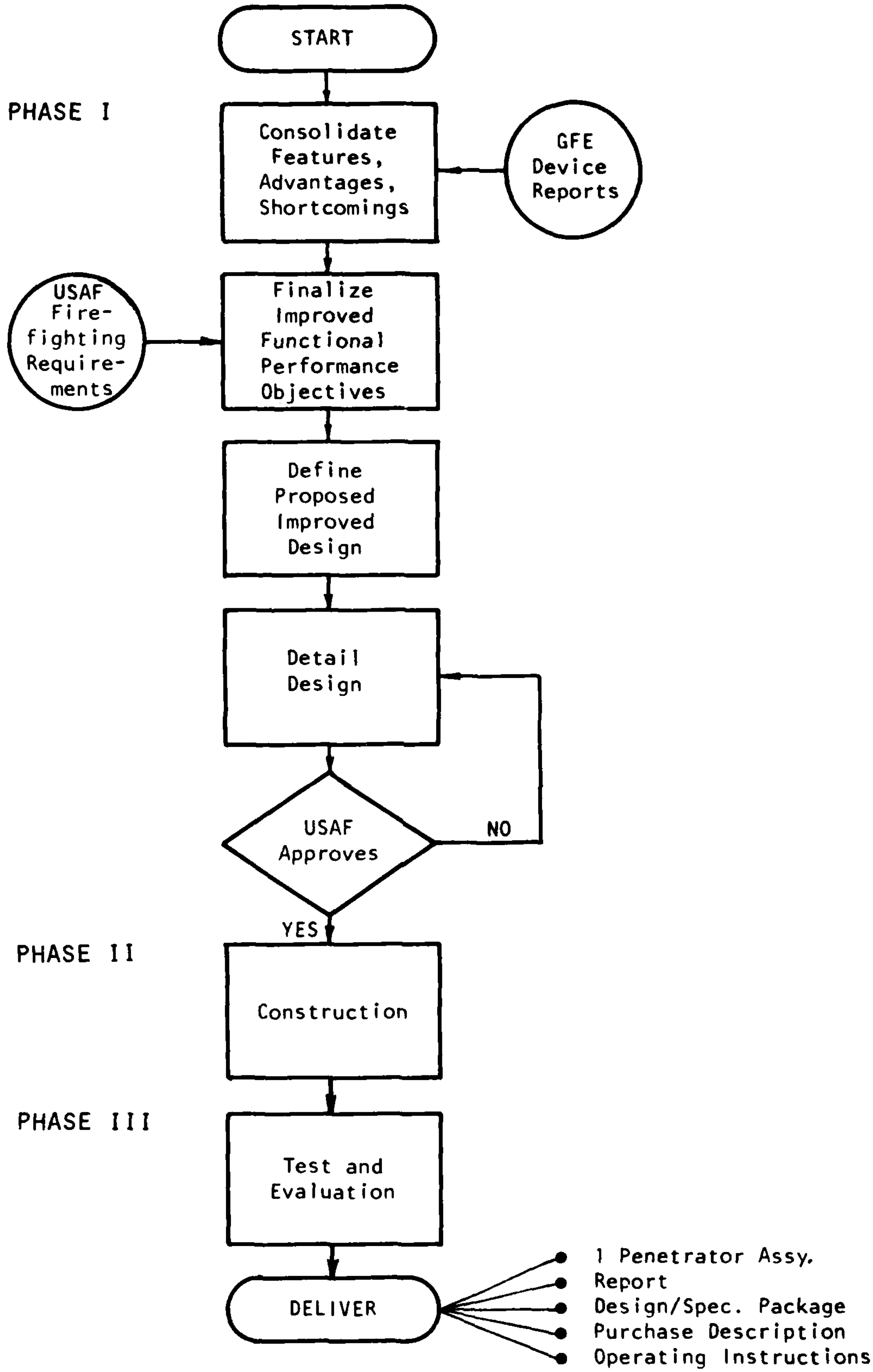

Figure 1. Overview Flow Chart of Program

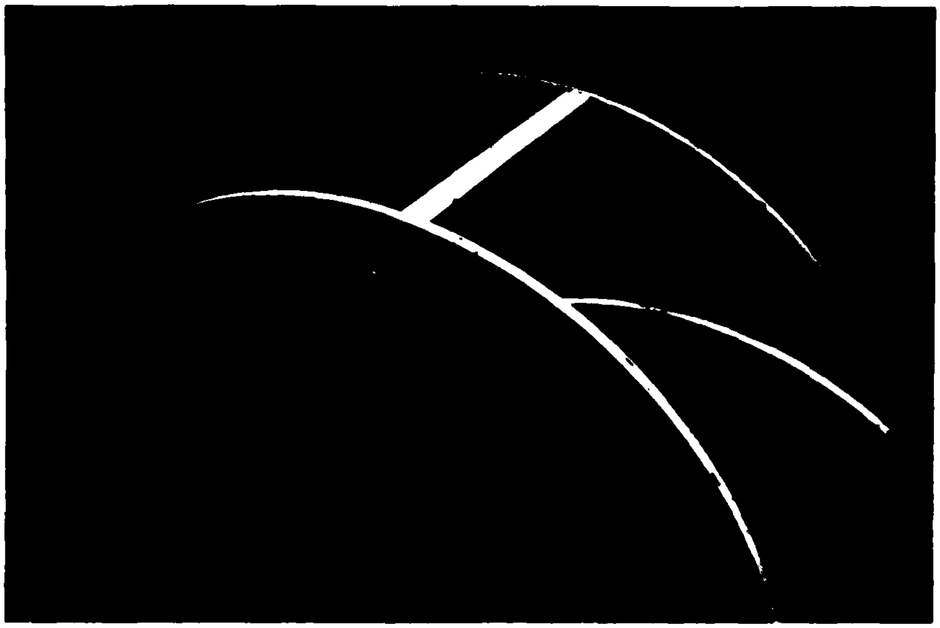

Figure 2. Test Buck for Mounting of Airframe Skin Panels.

simulated longeron members. The buck was designed to support a 16- by 24-inch test panel of simulated aircraft skin clamped to the surface with a 24-inch surface radius. The buck was also designed to support simulated inner cabin paneling as shown in Figure 3.

A quick-change C-clamp attachment system was devised to facilitate rapid change of panels. This is shown in Figure 4 with a panel in place.

The buck was fitted with a test penetrator support arm for adjustable mounting of an elastomeric spring energy storage and release device. Pivoted at the center of the airframe section, the arm can be rotated for repetitive testing in different positions on the same panel while maintaining a normal to surface impact direction. This is shown in Figure 5. A standard underwater spear gun was purchased to function as the spring energy storage and release device. A series of notches was added to the spear shaft for testing with alternative energy levels. These are also shown in Figure 5.

3. Penetration Testing - Point Slopes

Several alternative points were prepared as shown in Figure 6. A closeup view of one point ready for test is shown in Figure 7.

4. Analysis

Subjective human factor studies indicated 150 foot/pounds of stored energy is a maximum practical amount of energy to be transferred by physical exertion by a fully suited firefighter under fire conditions. Testing with 150 foot/pounds gave unsatisfactory results. Penetration was not achieved in skin panels of 2024-T6 aluminum alloy 0.090 inch thick. Furthermore, penetration was not achieved in this panel material with 300 foot/pounds of stored energy, double the amount. See Figures 8 through 11.

Testing also showed that tool recoil at 150 foot/pounds was feasible for hand-holding in selected body-arm postures but was not at 300 foot/pounds. At the higher energy levels, recoil of the simple low-cost tool was enough to knock the user down.

It was decided that the hand-cocked spring approach was not practical for a low-cost firefighting tool. (Anti-recoil features could be designed but not within the limitations of a low-cost, high-reliability tool.)

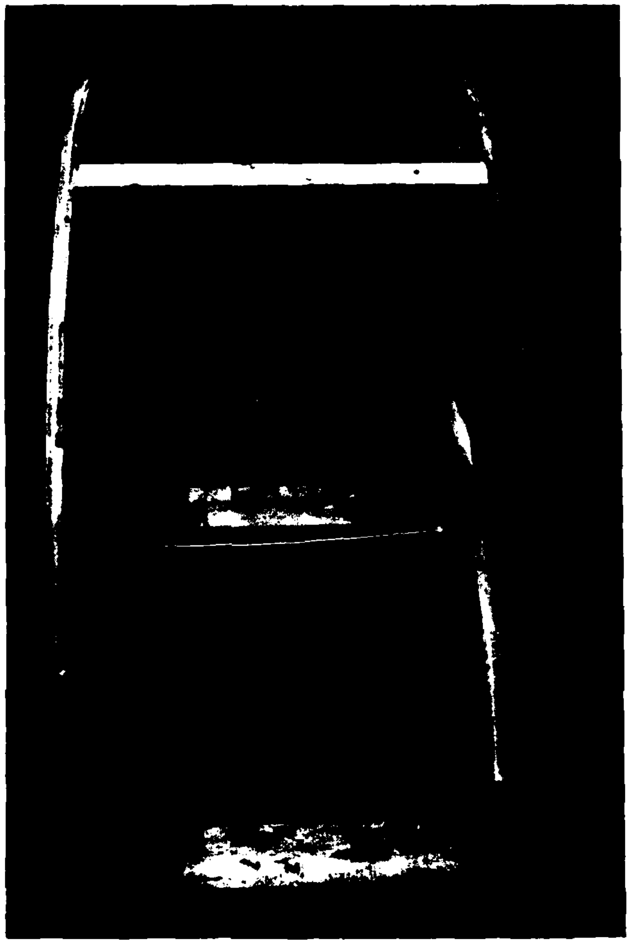

Figure 3. View of Test Buck Showing Mounting for Inner Cabin Panels and Insulation.

Figure 4. Simulated Skin Panel in Place on Test Buck Showing Quick-Change Clamp Feature.

Figure 5. Penetrator Support Fixture "Spear-Gun" Test Penetrator, Showing Alternative Energy Level Notches.

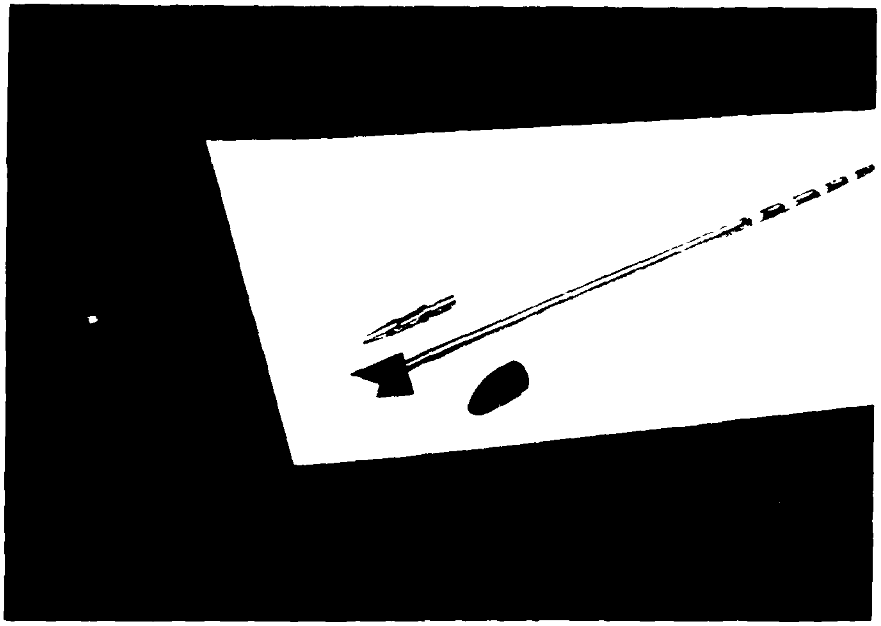

Figure 6. Alternative Points for Penetration Testing.

Figure 7. Closeup of One Point in Position on the Penetration Fixture Ready for Test.

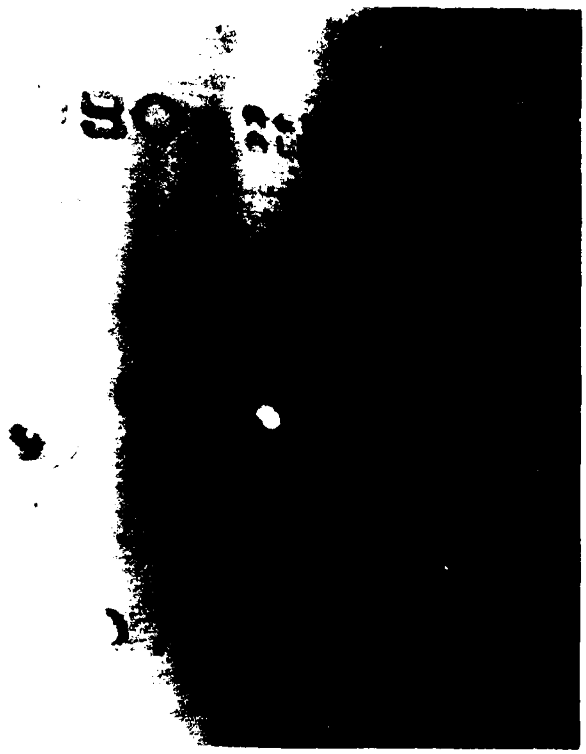

Figure 8. Lack of Penetration, 150 Foot/Pounds, 2024-T6 Aluminum Alloy, 0.090-Inch Thick.

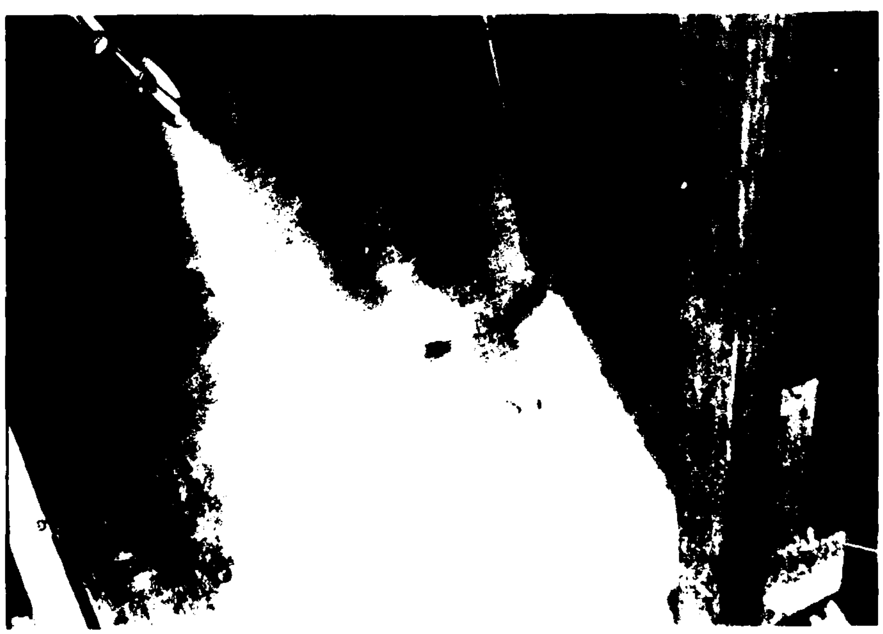

Figure 9. Similar Results at 300 Foot/Pounds.

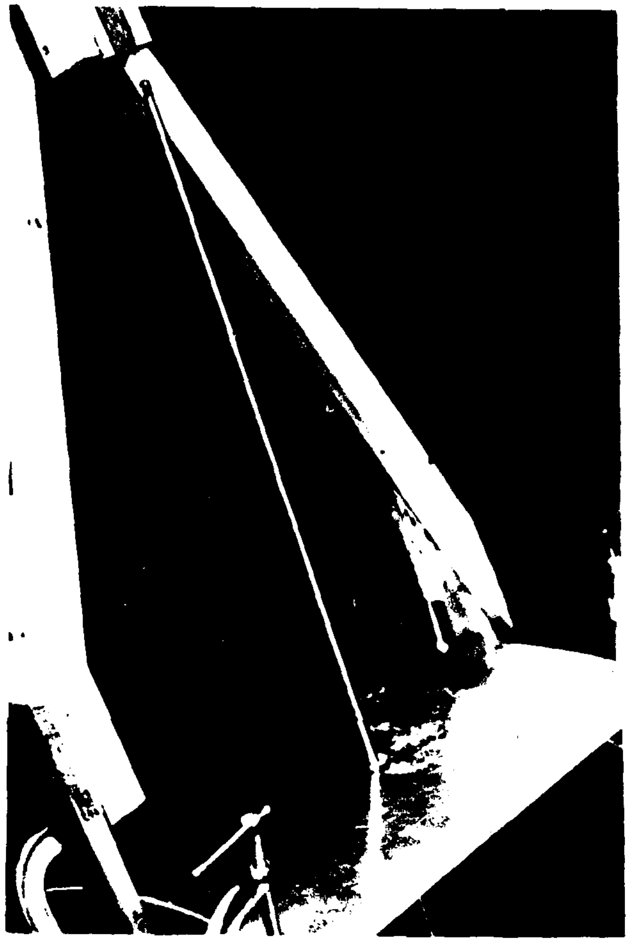

Figure 10. Penetration was Achieved in this 0.048-Inch Thick Panel at 250 Foot/Pounds of Energy.

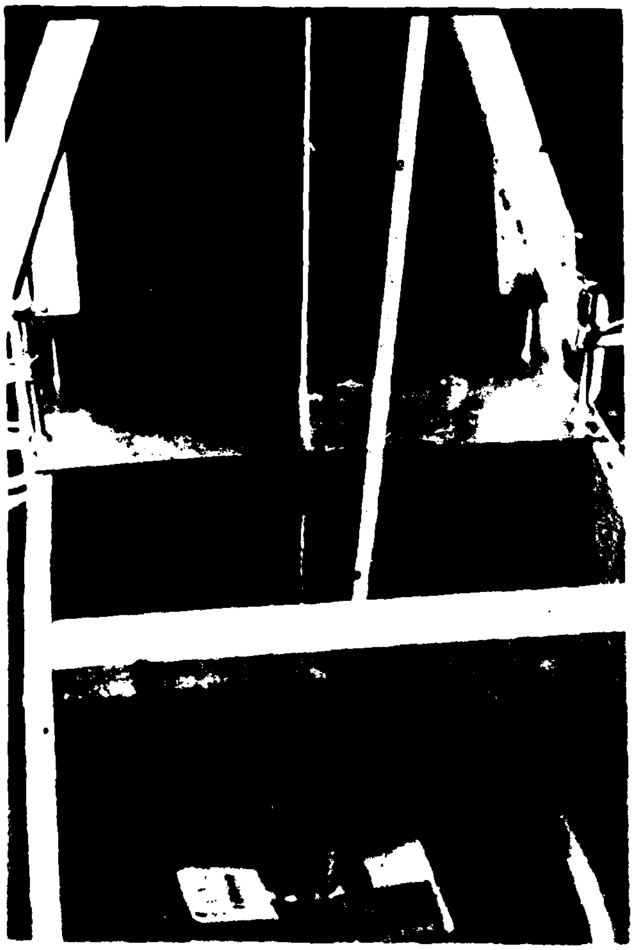

Figure 11. The Lance Penetrated Through the 0.048-Inch Thick Panel With 250 Foot/Pounds of Energy.

The decision was reinforced by a secondary consideration in the general area of firefighting tactics and practices which are beyond the scope of this project. The secondary consideration is "venting," a special practice often considered judicious in firefighting for selected situations. It was determined that even if the hand-cocked spring penetrator was able to penetrate, it could be used for only one hole and, therefore, could not perform a venting function if required by a firefighter. The desirability of venting, especially in closed and small aircraft compartments, is highly subjective. No position is taken in this report on the venting philosophy or practice. It was felt, however, that venting could well be a requirement in subsequent practices and procedures for the penetration firefighting techniques. Provision for venting was considered, therefore, an important capability for the tool.

The "Fire Protection Handbook," 14th Edition, NFPA, states the following:

> "Ventilation: Ventilation operations are the planned and systematic removal of heat, smoke, and fire gases from the structure. In some cases it may be necessary to commence ventilation prior to rescue in order to protect occupants from combustion products and heat until rescue operations can be completed. Also, it may be necessary to provide ventilation for visibility and tenability during rescue operations. Ventilation is also mandatory during confinement and extinguishment to aid in locating the fire and provide better working conditions for fire suppression personnel."

A different approach was then taken to accomplish system objectives in a low-cost, reliable system. The new design approach proved successful and was adapted as the principal recommendation of this report. The tool concept is based on using compressed air as an energy storage supply medium, a conventional industrial pneumatic drill as a power means, and a compact package of all the components for ease of use.

Compressed air is available at all fire and rescue facilities for recharging of air bottles so that no incremental cost is involved with the air bottle concept.

The pneumatic drill is a low-cost commercial module already available in many firefighting tool complements.

5. Functional Tests

Component and subsystem functional tests were conducted to prove out the concept. The tests are described in the series of photographs in Figures 12 through 24.

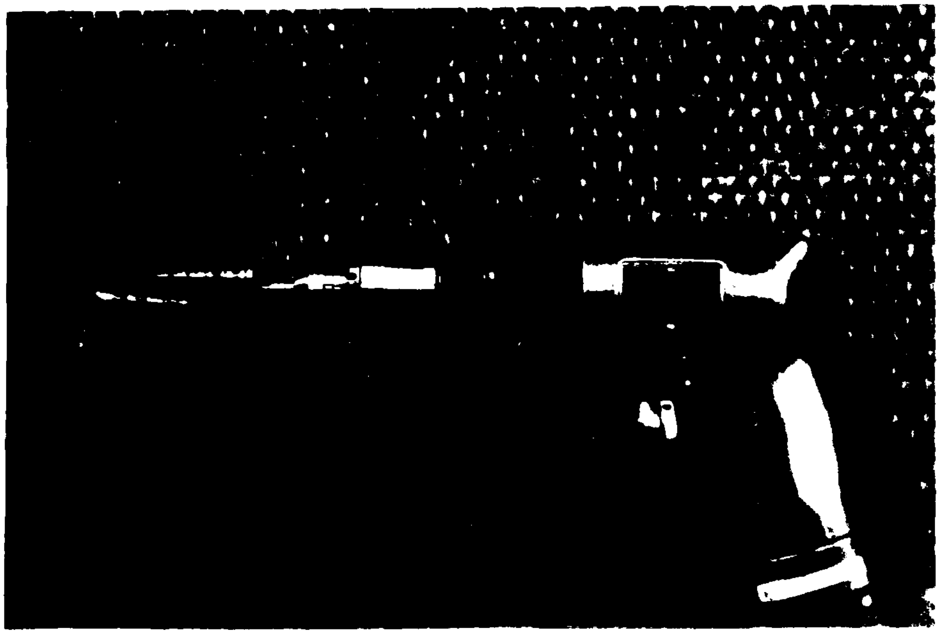

Figure 12. The Pneumatic Drill, the Drive Mechanism for AMETEK's Penetrator/Applicator Shown with Unique Penetrator Bit.

Figure 13. Beginning to Penetrate.

Figure 14. Twelve Seconds for Full Penetration to "Agent Turn-On Point."

Figure 15. A Second Hole Penetrated in the Same Panel.

Figure 16. A Range of Hole Penetration Sizes, From 1/2 Inch to 1-1/2 Inches, Evaluated for Accommodation of Various Flow Rate Nozzles.

Figure 17. A Range of Hole Sizes, From 1/2 Inch to 1-1/2 Inches, Being Penetrated.

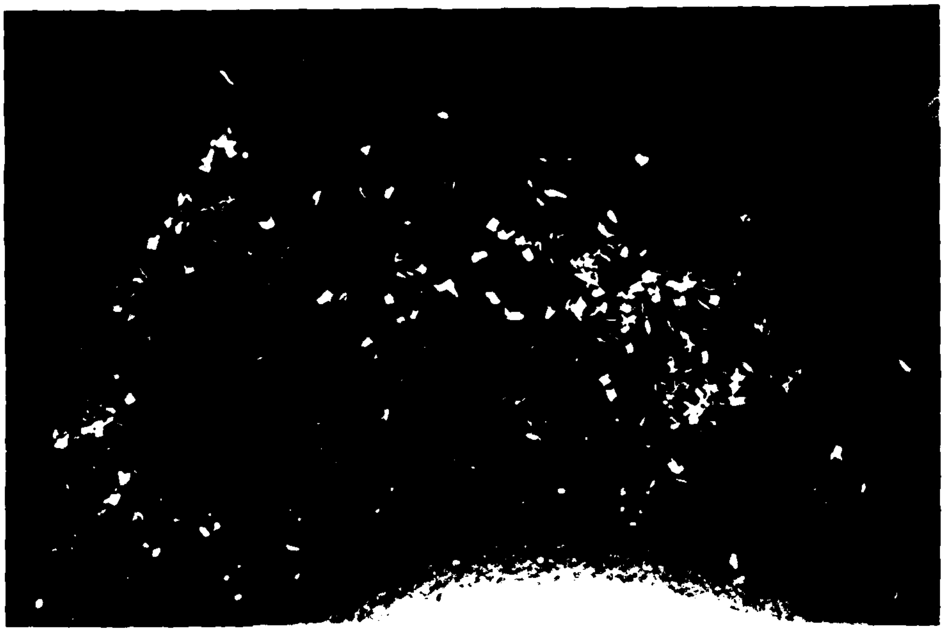

Figure 18. Chips Formation and Scatter Were Assessed and No Tool Jamming Occurred Nor is Anticipated.

Figure 19. Typical Chips.

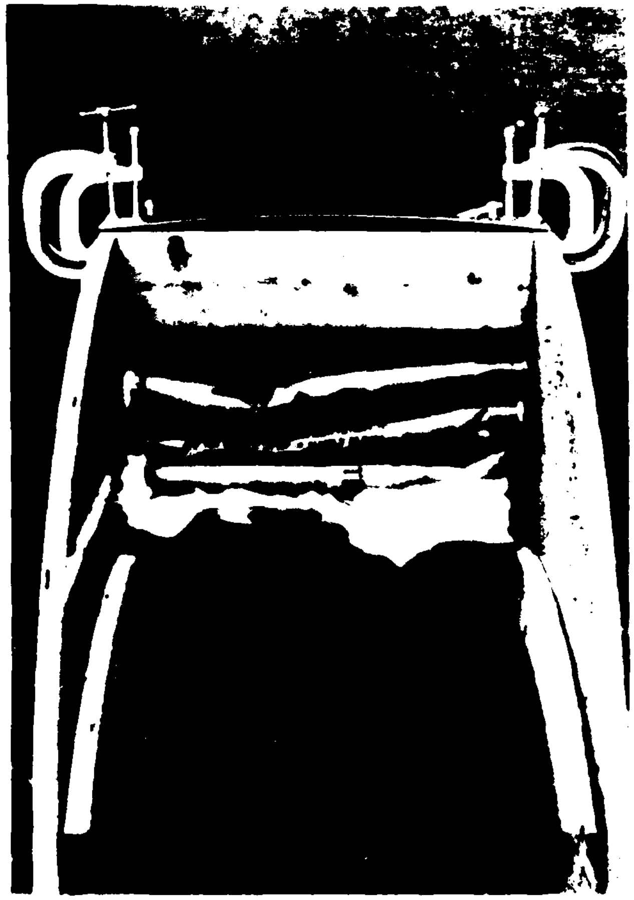

Figure 20. Test Buck Fitted With Internal Insulation and Fiberglass Inner Liner to Simulate Cabin Paneling.

Figure 21. The Full-Length Penetrator Without the Concentric Agent Flow Barrel Beginning to Penetrate.

Figure 22. Penetrating the Insulation Lining.

Figure 23. Penetrating the Cabin Liner.

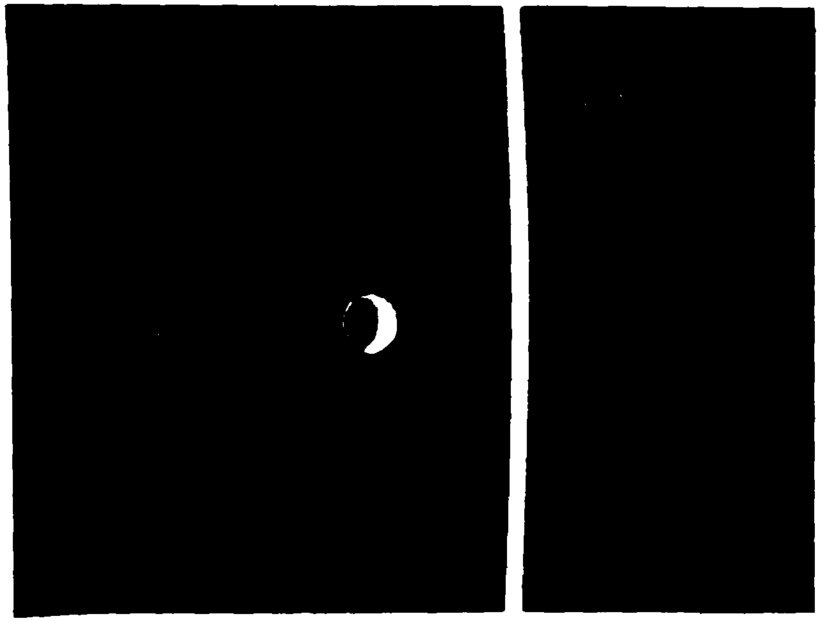

Figure 24. Hole Through the Cabin Liner - 14 Inches Inward From Skin - Complete - Ready for Agent Flow in 19 Seconds.

6. Detailed Design

A detailed design was prepared, following proveout of functional capability with the simulated aircraft skin.

C. DESCRIPTION OF TOOL CONCEPT

1. Concept

The general concept is shown in Figures 25 through 33.

2. Weight

The estimated weight of the tool is 22.3 pounds when fully charged and ready to penetrate. It is easily handled in a variety of positions, including overhead.

D. SYSTEM AND SUBSYSTEM ORGANIZATION

The following list shows the systems and subsystems of the Aircraft Penetrator/Agent Applicator tool.

System/ Subsystem Number	Title
1.0	Complete Tool Assembly
2.0	Penetrator
2.1	Tip
2.2	Drive
2.3	Energy Storage
2.4	Energy Release
2.5	Assembly Clamps
2.6	Energy Connection
3.0	Agent Transfer
3.1	Agent Connection
3.2	Shut-Off/On Valve
3.3	Conduit
3.4	Discharge Nozzle
4.0	Tool Retention
4.1	Retention Features

E. COST ESTIMATE

The tool cost is estimated as follows:

Quantity	Unit Cost
1	$2,250/ea.
10	1,250/ea.
100	975/ea.

Cost estimates do not include the agent supply line or line side connector.

The cost estimates are preliminary and should be used only for directional planning purposes at this time.

Figure 25. Fire is Observed Within an F-16 Internal Space in This Typical Parked Aircraft Situation.

Figure 26. The Penetrator/Agent Applicator is Brought by Fire Personnel and Penetration Is Started.

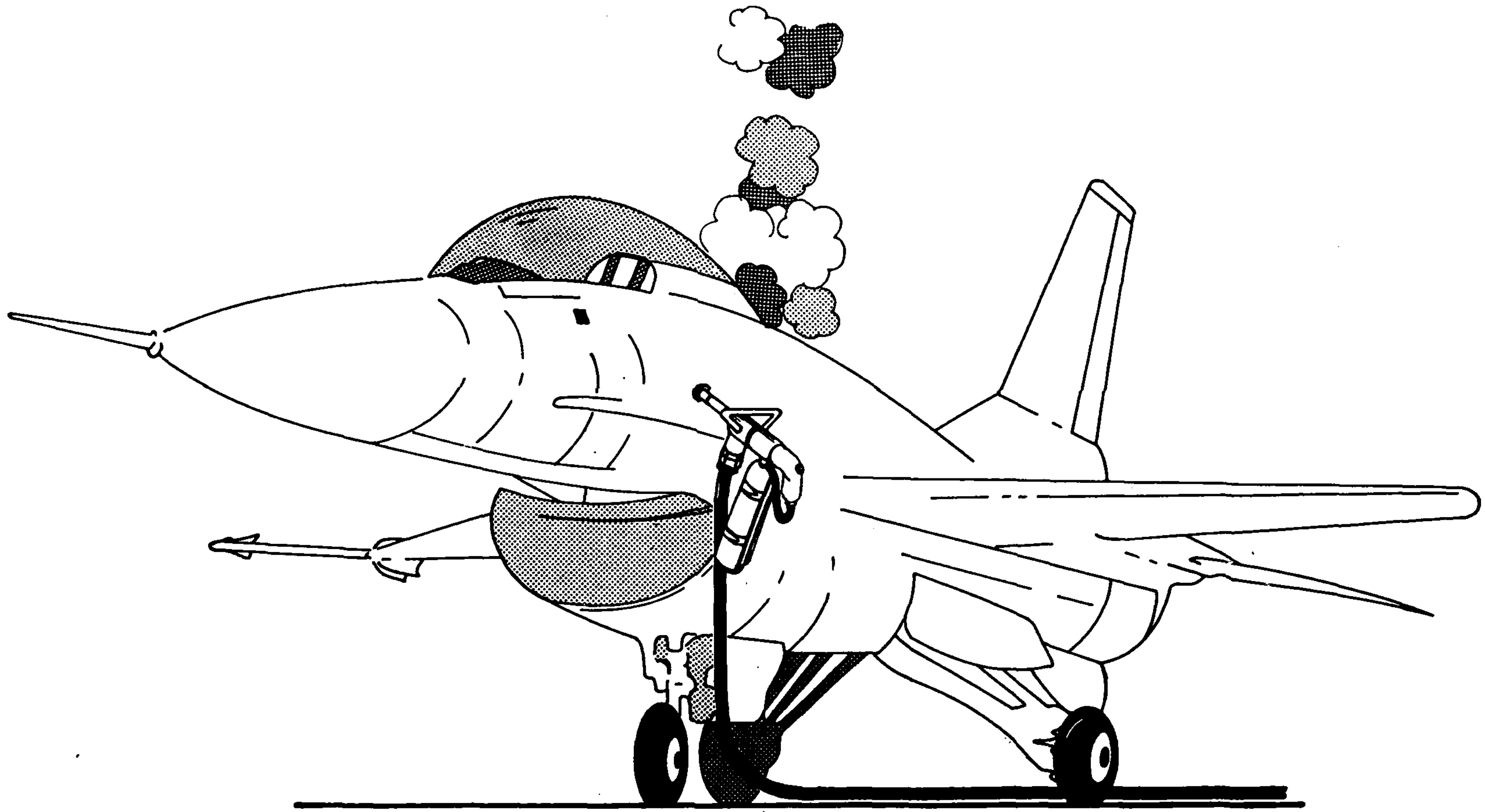

Figure 27. In 15 Seconds, the Firefighter Turns on the Halon 1211 and Leaves the Tool in Place.

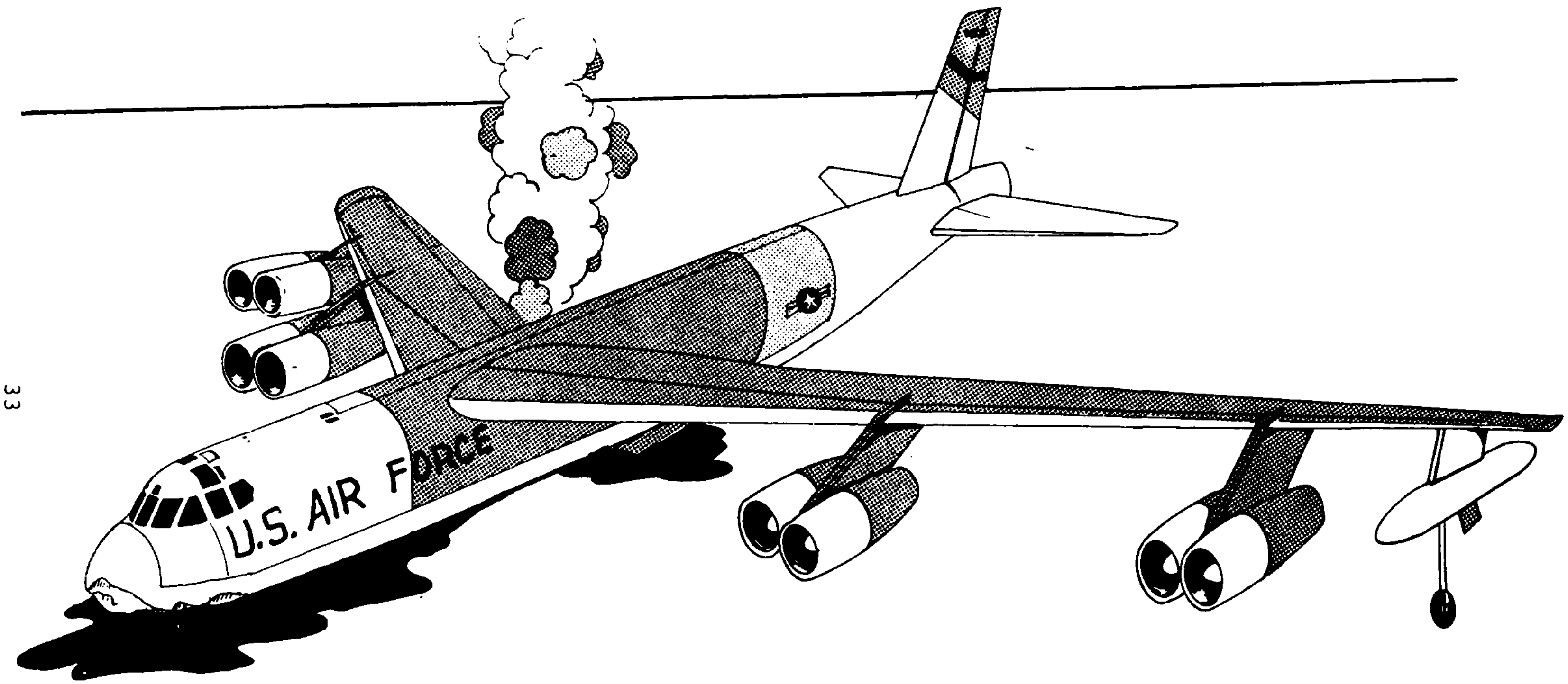

Figure 28. Fire in a B-52.

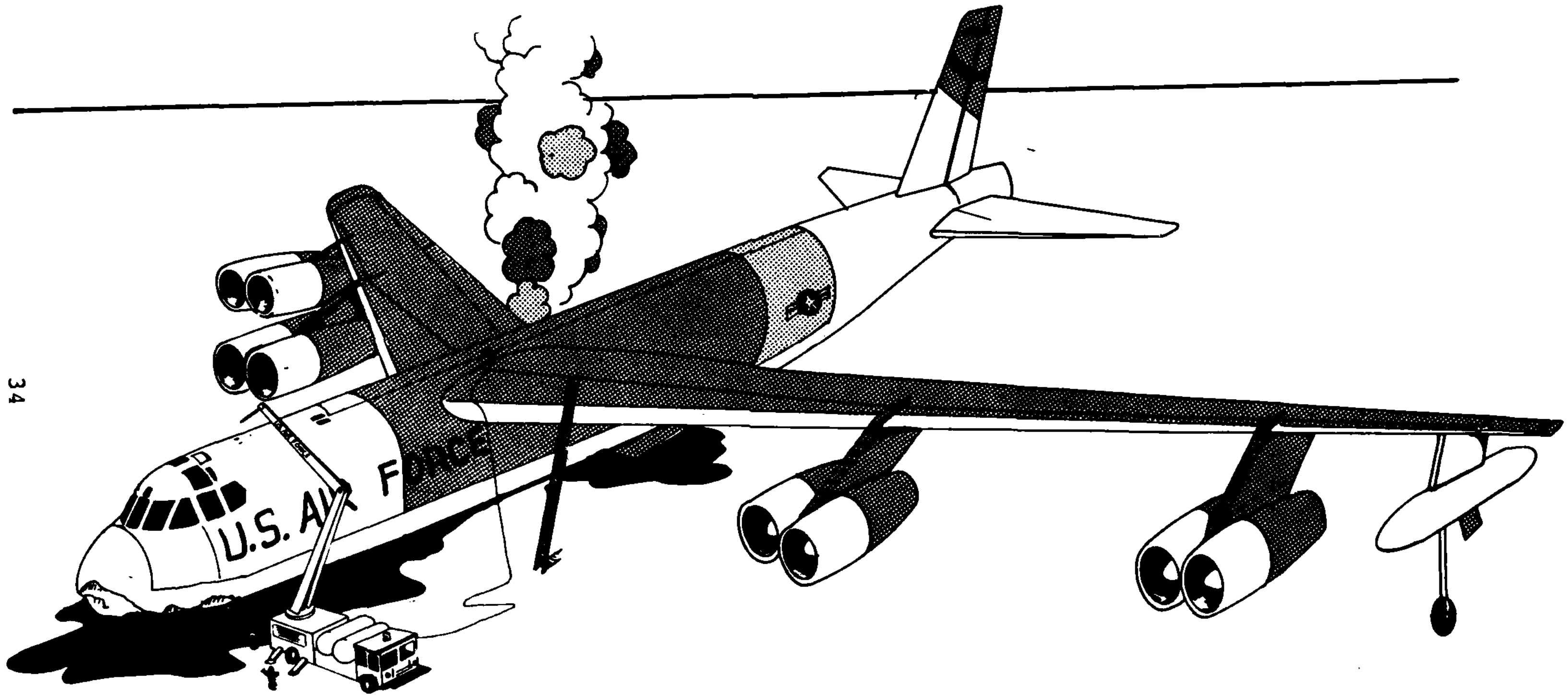

Figure 29. AMETEK's Tool Being Used by a Firefighter on Top of the Wing.

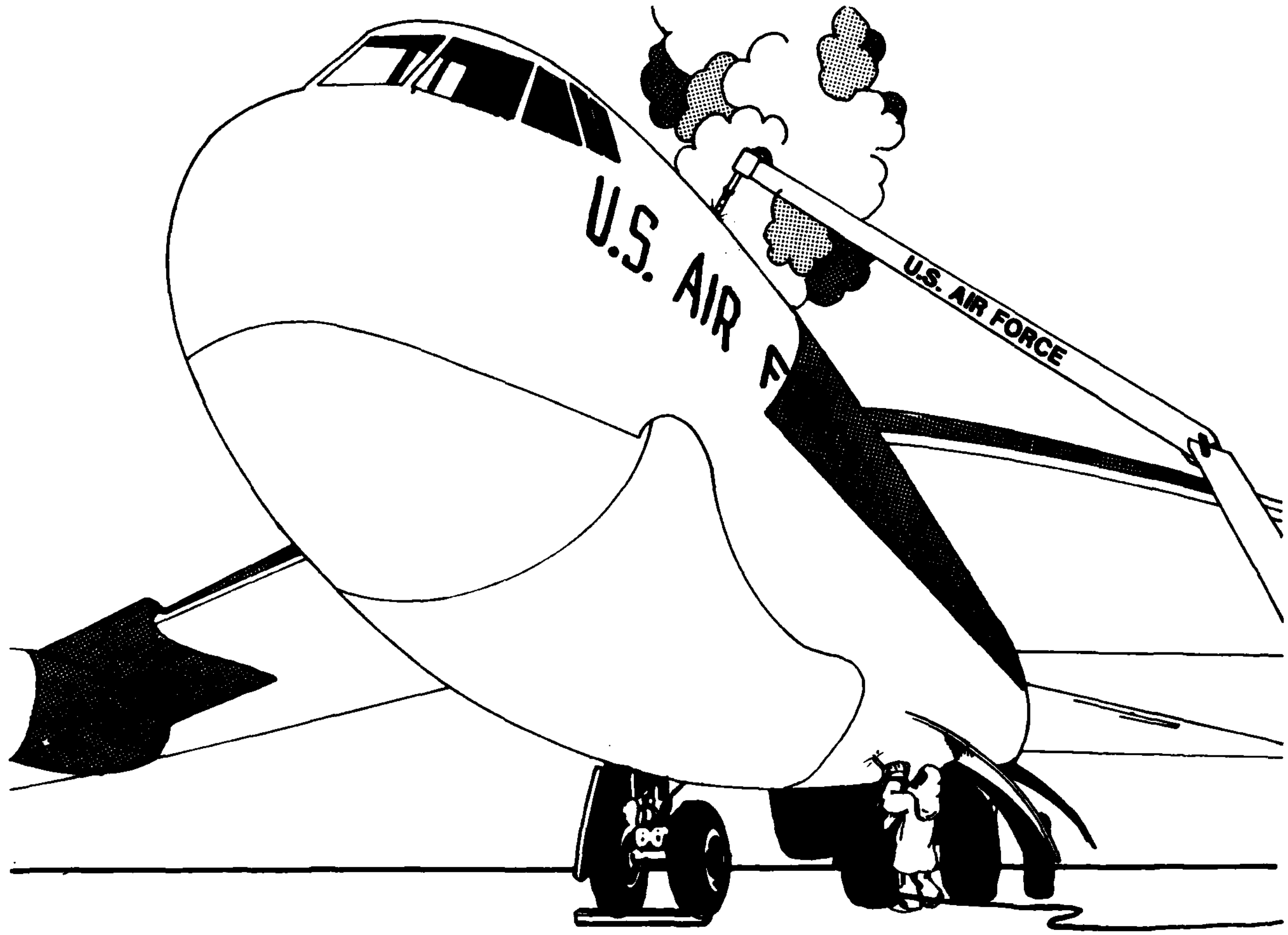

Figure 30. Alternate Usages; by a Firefighter From the Ground and From a Vehicle-Mounted Arm on Top.

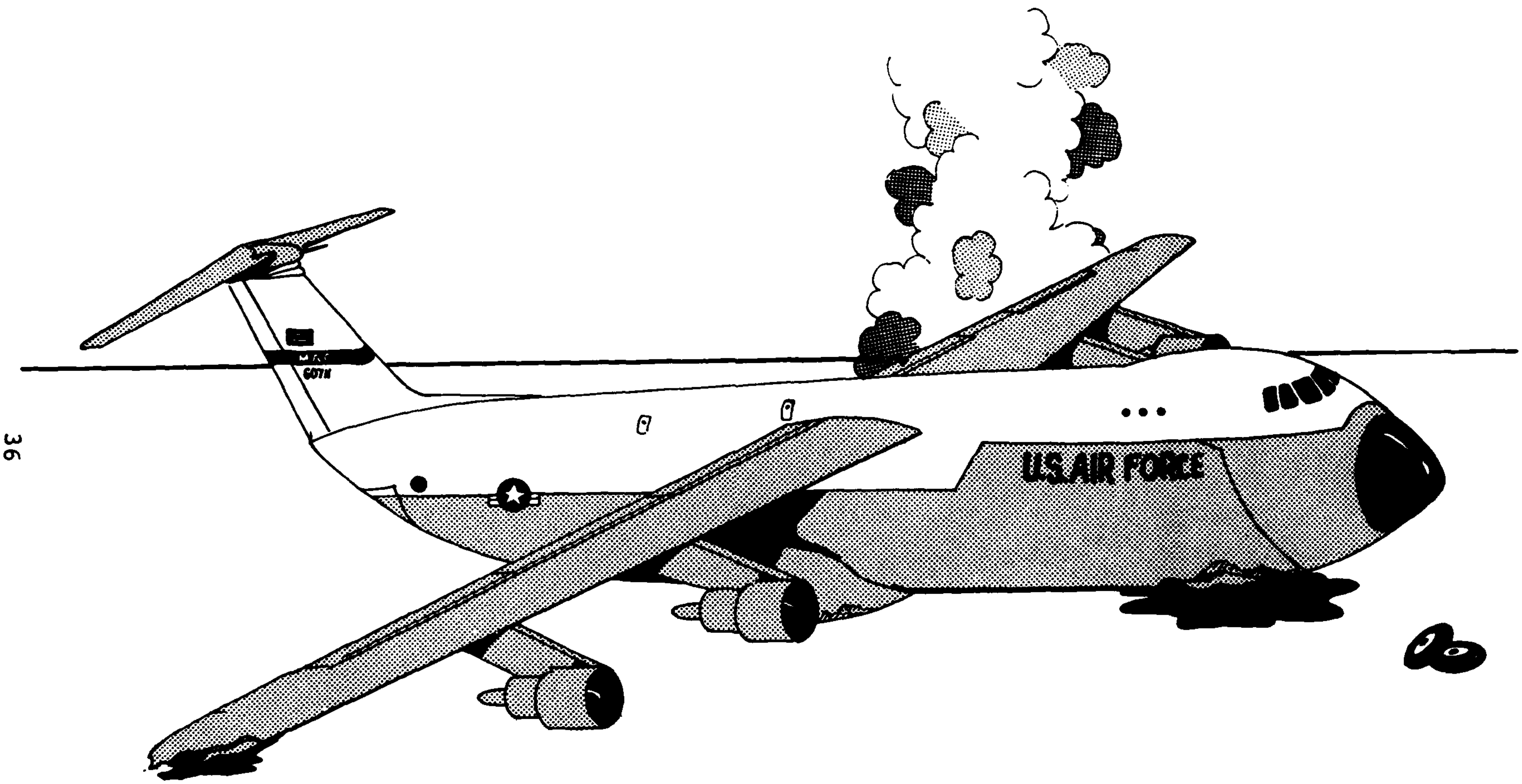

Figure 31. A C-5A With an Internal Fire.

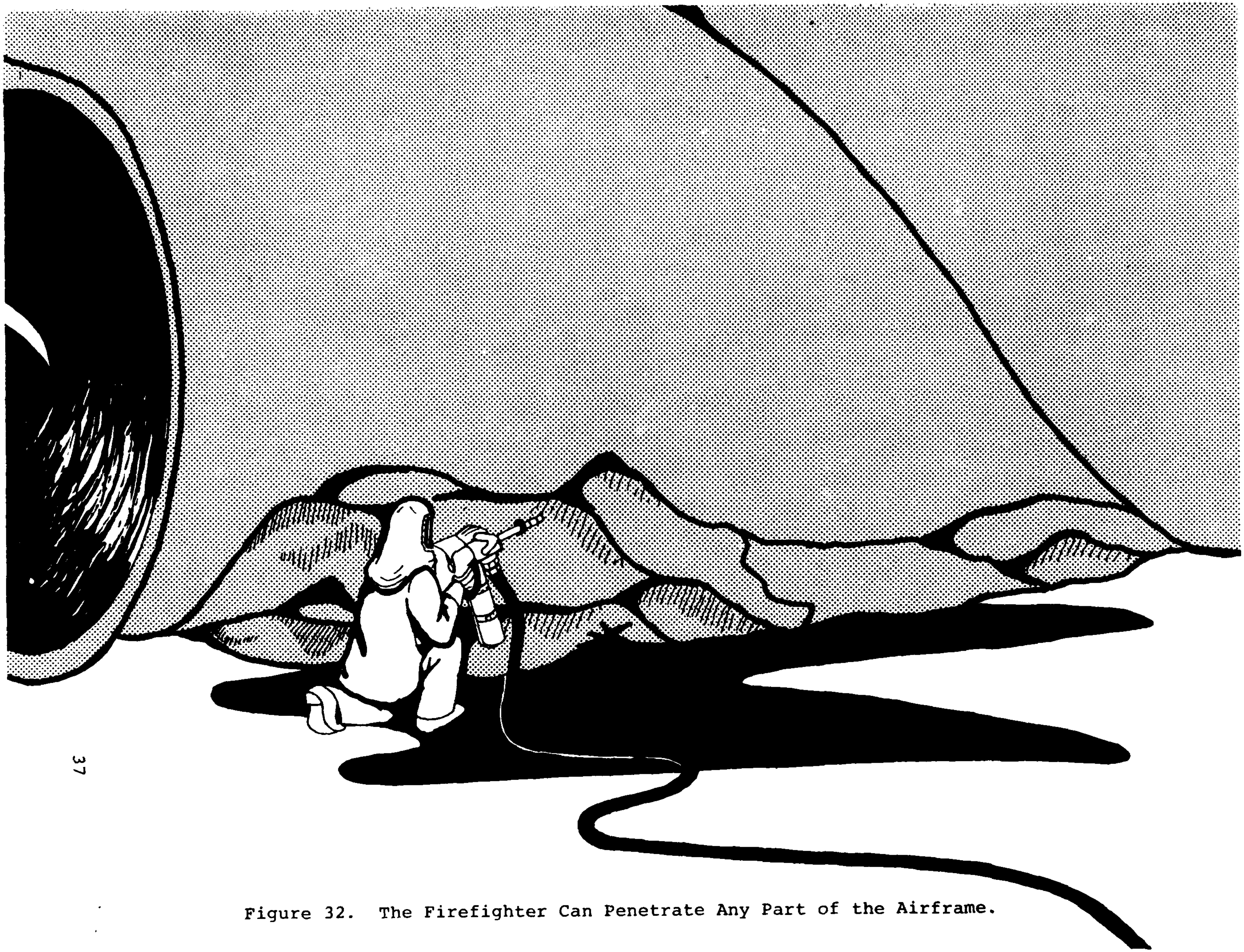

Figure 32. The Firefighter Can Penetrate Any Part of the Airframe.

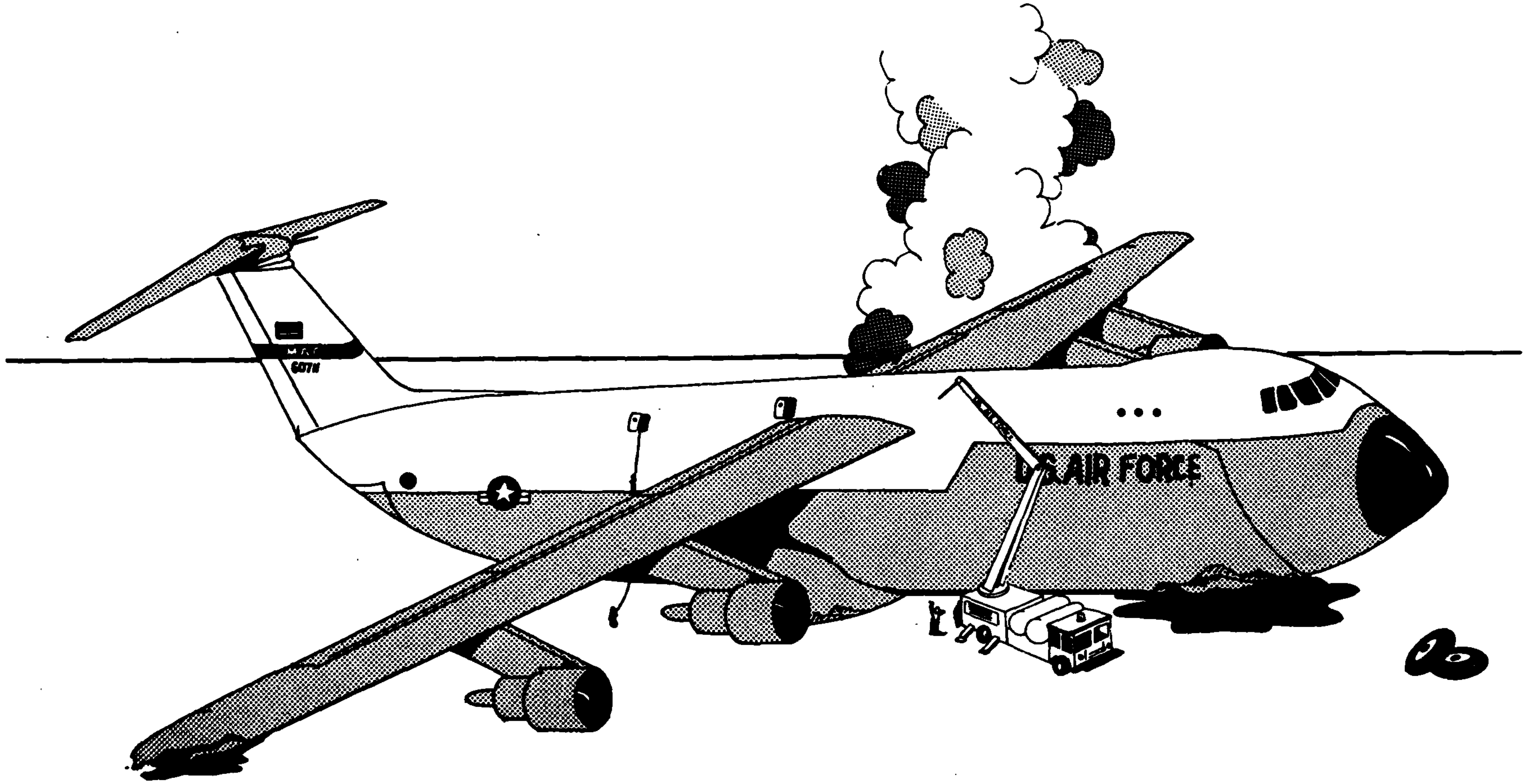

Figure 33. The AMETEK Penetrator/Applicator is Ideal for Large Aircraft.

SECTION III

PHASE II - WORKING MODEL CONSTRUCTION

The Aircraft Skin Penetrator/Agent Applicator as-built working model is shown in Figures 34 through 39. The Applicator was constructed using the drawings shown as Figures 40 through 44.

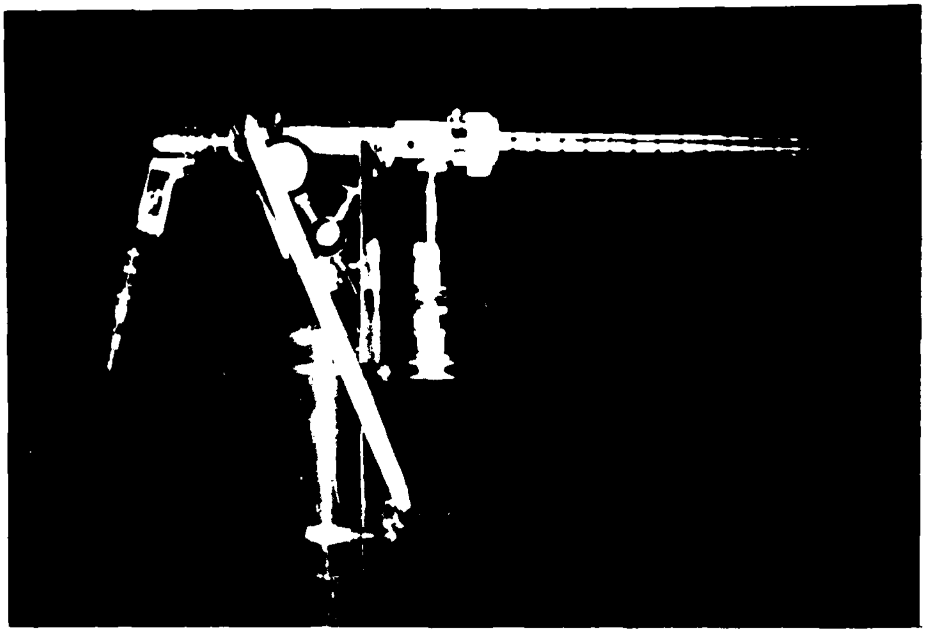

Figure 34. Right-Side View of Aircraft Skin Penetrator/Agent Applicator.

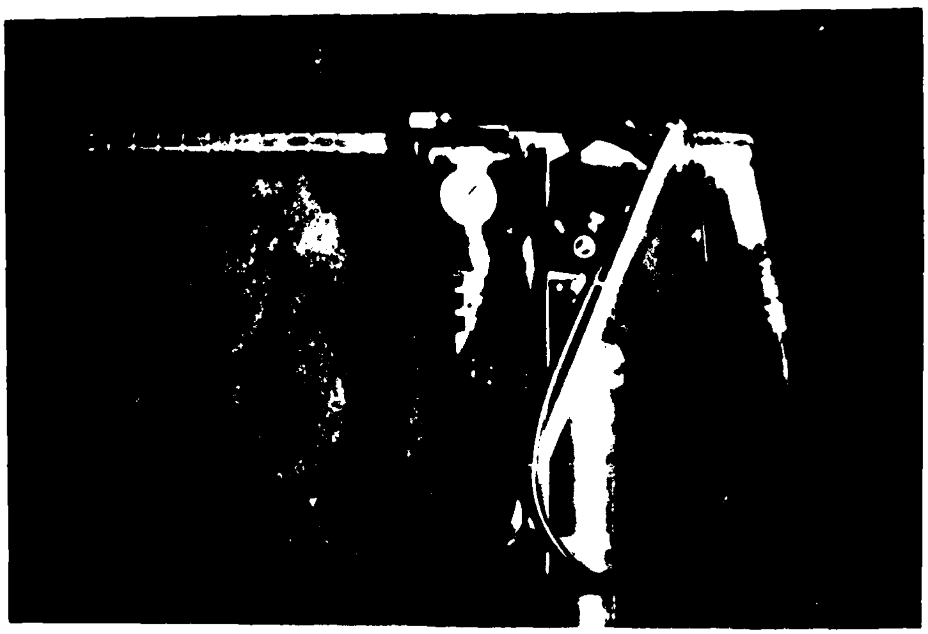

Figure 35. Left-Side View of Aircraft Skin Penetrator/Agent Applicator.

Figure 36. Rear View of Aircraft Skin Penetrator/Agent Applicator.

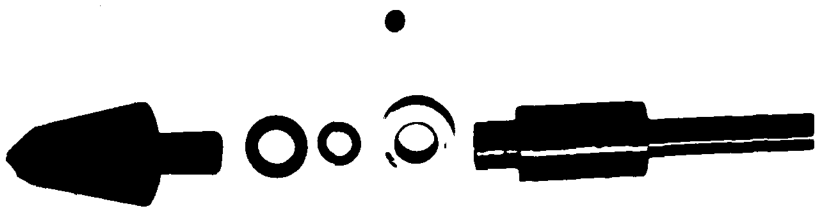

Figure 37. Tool Bit, Front Bearing Assembly, Tool Bit/Shaft Adapter and Drive Shaft.

Figure 38. Pressure Testing and Flow Testing of the Aircraft Skin Penetrator/Agent Applicator Before Initial Use.

Figure 39. First Checkout of the Aircraft Skin Penetrator/Agent Applicator Penetrating an Actual Wing Section.

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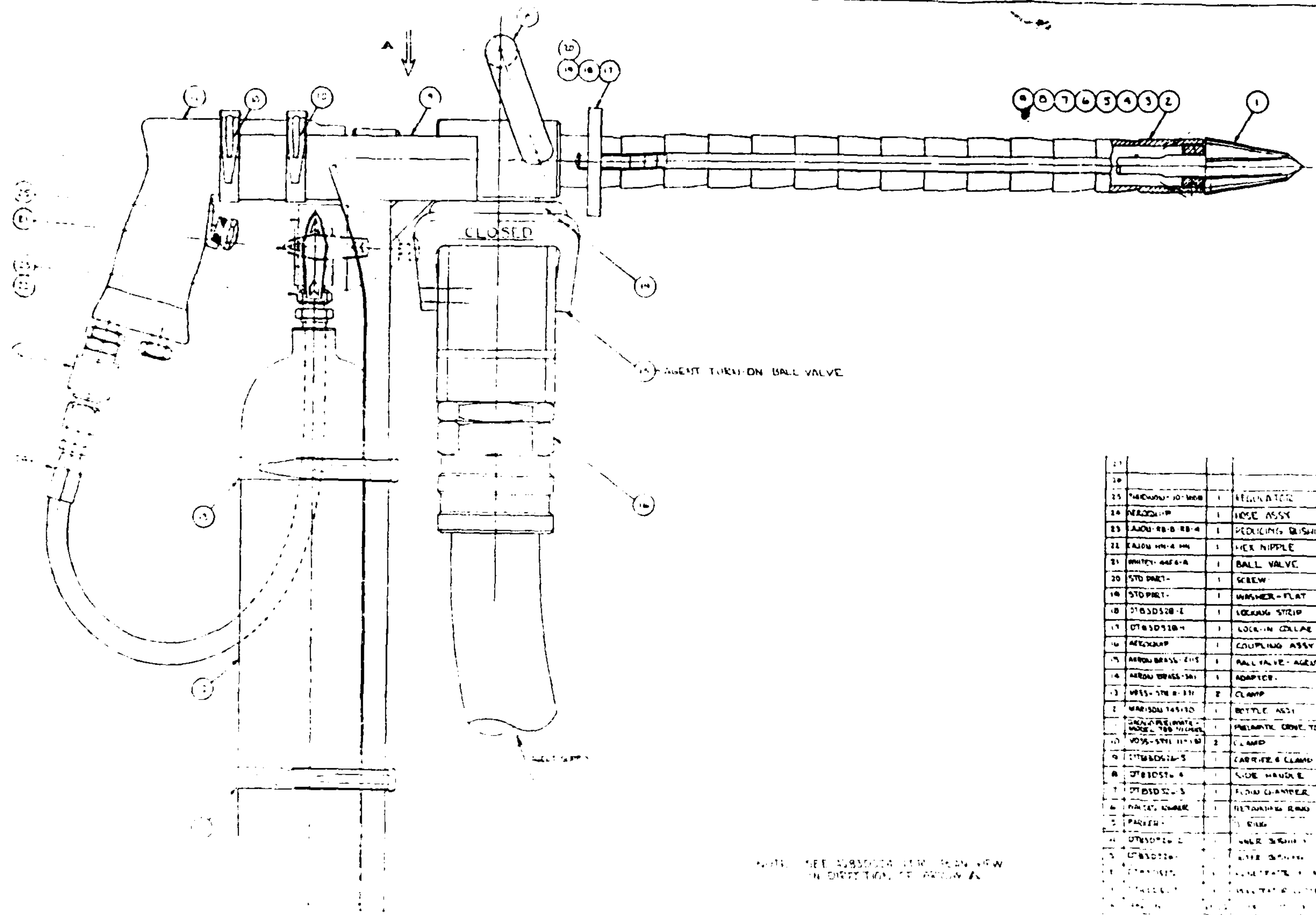

NOTE: SEE [illegible] FOR PLAN VIEW IN DIRECTION OF ARROW A

27				
26				
25	[illegible]-10-[illegible]	1	REGULATOR	
24	AEROQUIP	1	HOSE ASSY	
23	CAJON-RB-8-RB-4	1	REDUCING BUSHING	
22	CAJON HN-4 HN	1	HEX NIPPLE	
21	WHITEY-44F4-A	1	BALL VALVE	
20	STD PART-	1	SCREW	
19	STD PART-	1	WASHER-FLAT	
18	DT8SD528-2	1	LOCKING STRIP	
17	DT8SD518-4	1	LOCK-IN COLLAR	
16	AEROQUIP	1	COUPLING ASSY	
15	AERO BRASS-[illegible]	1	BALL VALVE - AGENT SHUTOFF	
14	AERO BRASS-[illegible]	1	ADAPTOR	
13	VOSS-STYLE-[illegible]	2	CLAMP	
12	MARISON 145130	1	BOTTLE ASSY	
11	[illegible] PNEUMATIC - MODEL 700 [illegible]	1	PNEUMATIC DRIVE TOOL	
10	VOSS-STYLE [illegible]	2	CLAMP	
9	DT8SD526-5	1	CARRIER & CLAMP FRAME	
8	DT8SD526-4	1	SIDE HANDLE	
7	DT8SD526-3	1	FLOW CHAMBER	
6	[illegible]	1	RETAINING RING	
5	PARKER-		O RING	
4	DT8SD526-2		[illegible]	
3	DT8SD526-		[illegible]	
2	[illegible]		[illegible]	
1	[illegible]		[illegible]	

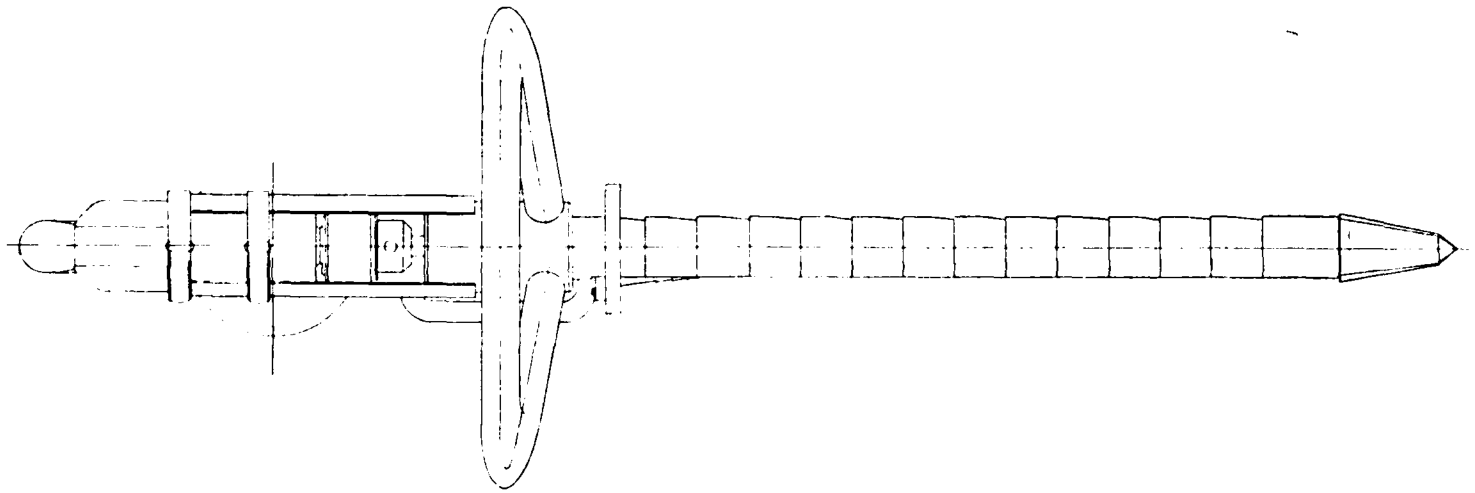

Figure 41. Plan View, Penetrator/Agent Applicator Assembly.

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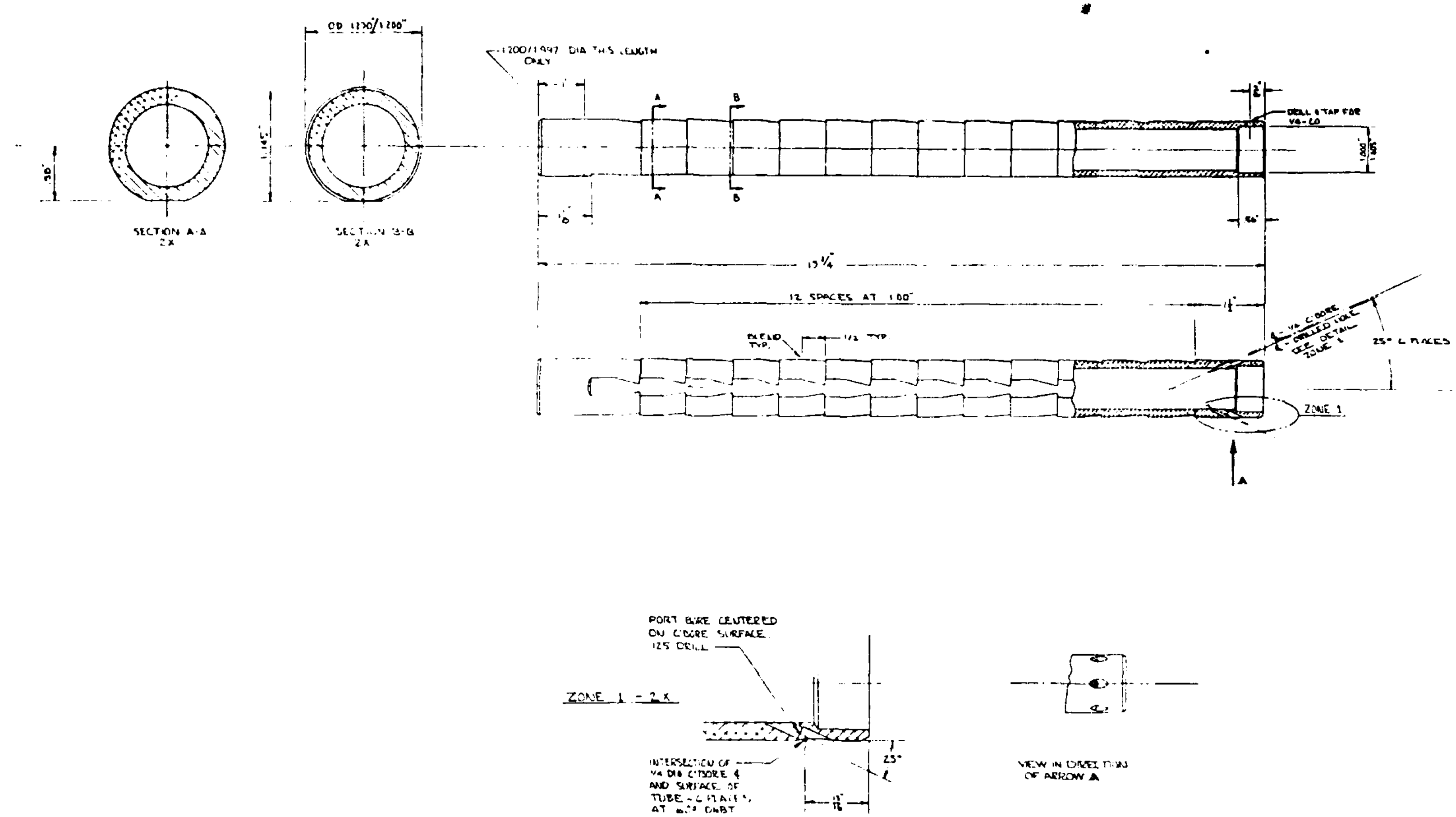

Figure 42. Penetrator Flow Barrel.

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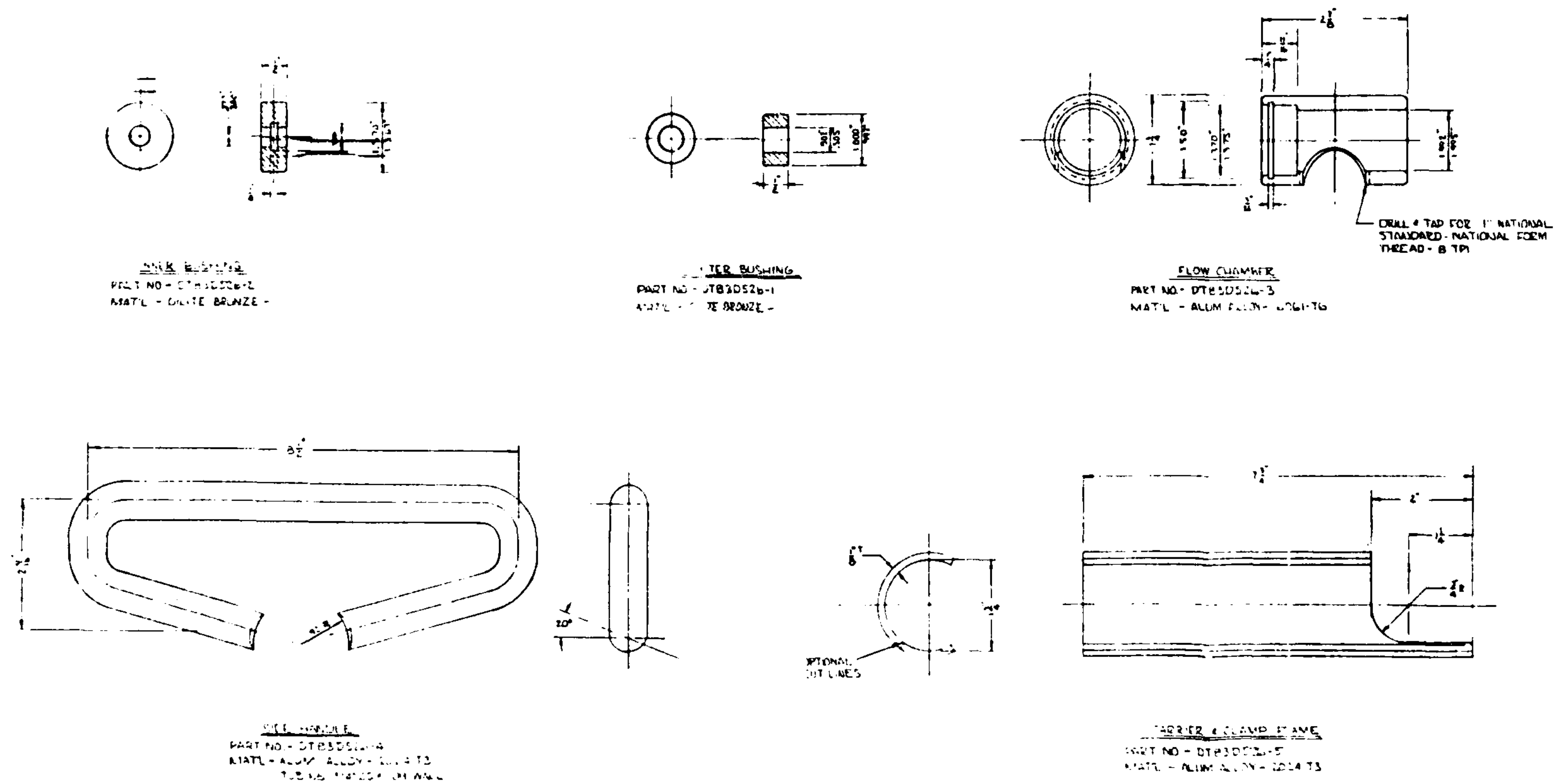

Figure 13. Flow Barrel Assembly Details.

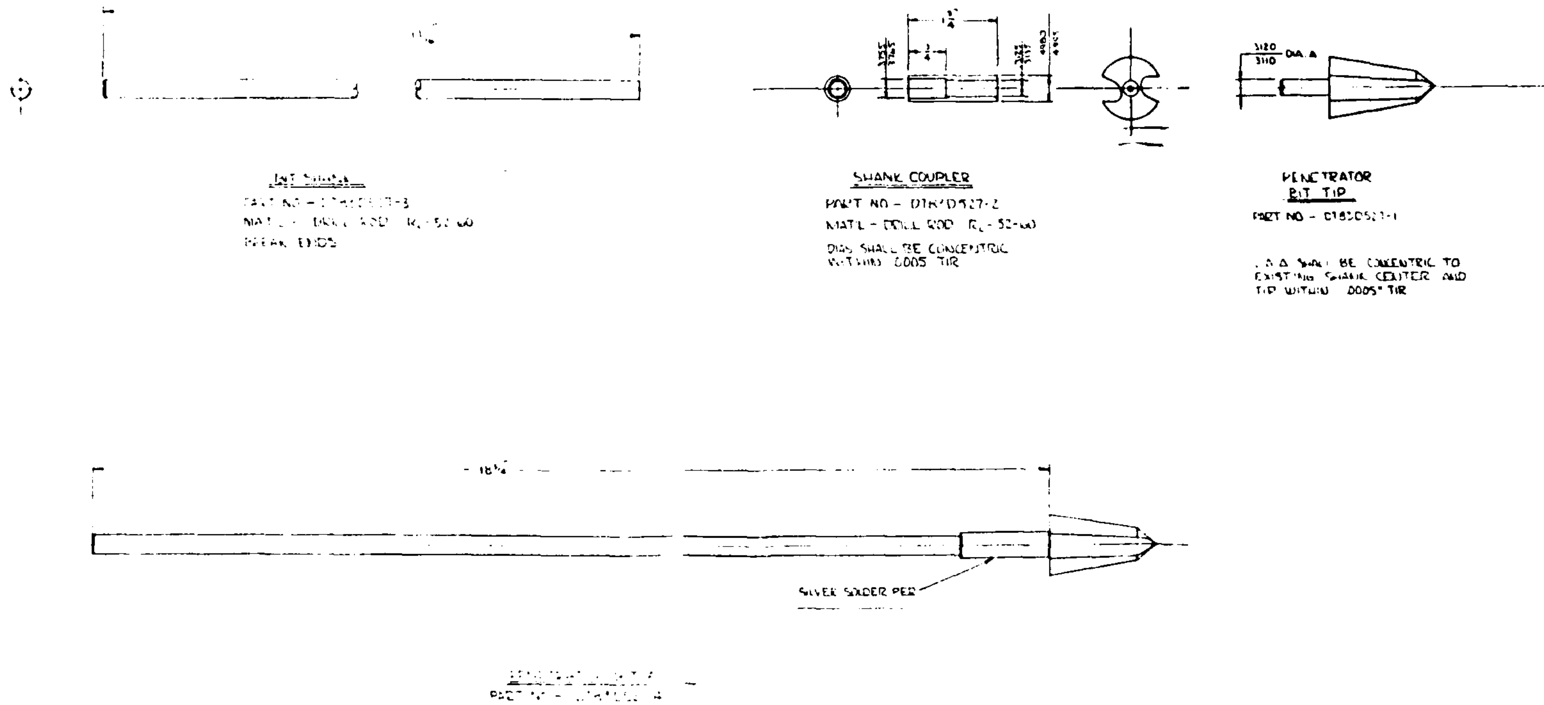

Figure 14. Penetrator Cutter.

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SECTION IV

CONCLUSIONS AND RECOMMENDATIONS

In general, the acceptance tests revealed that the concept of utilizing the Aircraft Skin Penetrator/Agent Applicator is valid and that the prototype unit is capable of piercing aircraft skin and applying firefighting agent quickly to areas not otherwise readily accessible. However, certain functional and design deficiencies were revealed during the test program. Positive action on the recommendations to correct these deficiencies will improve the capability of the unit. Upon acceptance of the recommendations, the improved unit should be tested to evaluate the changes and modifications.

A. CONCLUSIONS

The following deficiencies were revealed during the test program.

1. The overcenter clamps were not tight enough to keep the drill motor from turning during actual drilling operations.

2. The barrel and Halon valve leaked Halon 1211 when pressurized to 200 psi.

3. The length of the air storage bottle made the unit too heavy and the center of gravity poor.

4. Securing the tool bit to the drive shaft through an adapter and pins is too expensive to manufacture and is also prone to loosening.

5. The drill motor should be lubricated by injecting oil into the quick-disconnect valve.

6. An additional gauge should be mounted onto the air regulator to find the air storage bottle pressure.

7. Air Force fire departments cannot charge air storage bottles with SCUBA valves.

8. The air regulator does not fit a CGA valve fitting.

9. The unit should have a top forward handle.

B. RECOMMENDATIONS

The following recommendations are suggested to correct the deficiencies described above.

1. Redesign the flow chamber so that the drill motor will lock securely in place.

2. Redesign the flow chamber so that the barrel and Halon valve will thread into it, resulting in a positive seal.

3. Change the air storage bottle to a composite type with a storage pressure capability of 3000 psi.

4. Silver solder the tool bit to the drive shaft.

5. Install an automatic lubricator into the drill motor air supply line.

6. Change the air storage bottle valve to one that incorporates a storage bottle pressure gauge and a standard Compressed Gas Association (CGA) fitting built into it.

7. Design an adapter to adapt the air regulator to the air storage bottle CGA valve fitting.

8. Add a top forward handle.

REFERENCES

1. Partin, B. J., and Kuykendall, B. L., Development Test and Evaluation/Initial Operational Test and Evaluation - Powered Aircraft Skin Penetrator/Agent Applicator, AFCEC ER 74-8, Air Force Civil Engineering Center, Air Force Systems Command, Tyndall Air Force Base, Florida, September 1974.

2. O'Neill, J. H., Urban, C. H., and Geyer, G. B., Preliminary Assessment of the Effectiveness of a Ballistically Powered Aircraft Skin Penetrator Nozzle in Extinguishing an Aircraft Cabin Fire with Aqueous-Film-Forming Foam, NA-79-55-LR, Federal Aviation Administration, National Aviation Facilities Experimental Center, Atlantic City, New Jersey, October 1979.

3. National Aeronautics and Space Administration, Technical Support Package for Penetrating Fire Extinguisher, KSC-11064, NASA Tech Briefs, Vol. 3, No. 3, U.S. Government Printing Office, Washington, D.C. 20402.

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